# NORTHERN SPOTTED OWL MONITORING ANNUAL REPORT, FY 2012

## 1. Title:

Demographic characteristics of northern spotted owls (*Strix occidentalis caurina*) in the Klamath Mountain Province of Oregon, 1990-2012.

## 2. Principal Investigators and Organizations:

Ray Davis (Principal Investigator); R. Horn (Lead Biologist); Biologists: P. Caldwell, R. Crutchley, E. Erickson, K. Fukuda, T. Kaufmann, C. Larson, H. Wise.

## 3. Study Objectives:

The study objectives are to estimate the population parameters of northern spotted owls on the Klamath Study Area (KSA) within the Klamath Mountain Province. These parameters include occupancy, survival and reproductive success. The lands are administered by the USDI Bureau of Land Management (BLM), Glendale Field Office of the Medford District and South River Field Office of the Roseburg District.

## 4. Potential Benefit or Utility of the Study:

The KSA is one of eight long-term northern spotted owl study areas designed to assess the status and trends in northern spotted owl populations and habitat as directed under the Northwest Forest Plan (USDA and USDI 1994). The data from these studies were recently analyzed as part of a rangewide meta-analysis workshop (Forsman et al. 2011a). The survival and reproductive data has and will be used in population modeling to assess the long-term stability of the population (Franklin et al. 1999). Data from several study areas has also been used in the development of habitat suitability models and maps for the spotted owl (Lint et al. 1999, Anthony et al. 2000, Lint 2005, Davis et al. 2011, USFWS 2011).

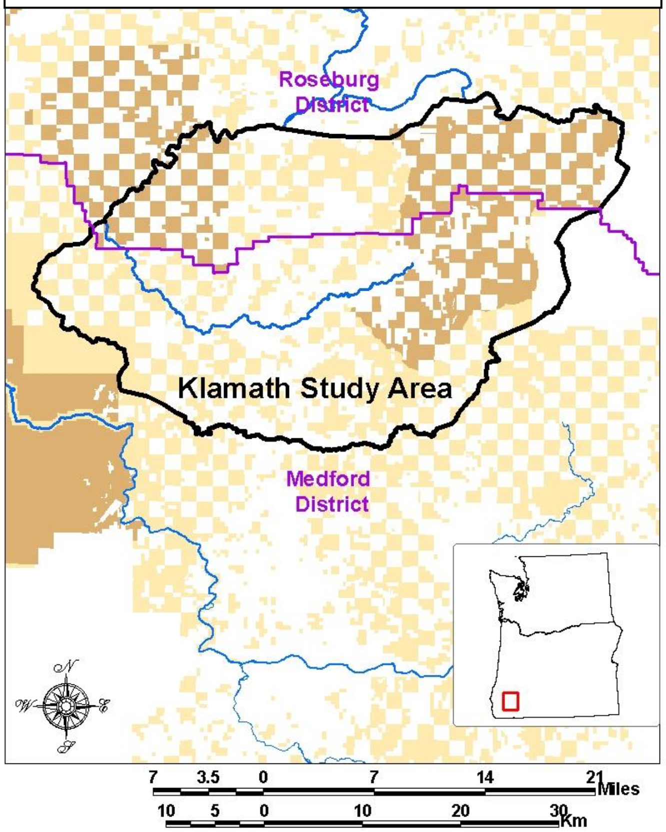
## 5. Study Area Description and Survey Design:

The KSA was located within the Klamath Mountains Physiographic Province in Southwestern Oregon and was approximately 1422 km$^2$ (351,334 ac) in size (Figure 1). This province was characterized by mixed conifer forests dominated by Douglas-fir (*Pseudotsuga menziesii*) and incense cedar (*Calocedrus decurrens*). Other common species included pine (*Pinus* spp.), grand fir (*Abies grandis*), pacific madrone (*Arbutus menziesii*), golden chinquapin (*Castanopsis chrysophylla*), and oak (*Quercus* spp.) (Franklin and Dyrness 1973). Owl sites within the current boundaries of the KSA were systematically surveyed from 1997 to present. A smaller study area (about 466 km$^2$; 115,138 ac) was systematically surveyed from 1990-1994 and was within the current study area boundary.

The KSA included portions of two BLM Districts in Western Oregon (Medford and Roseburg) and much of the intervening areas of private and state lands. The federal lands were primarily in an alternating "checkerboard" pattern of ownership with private lands. Of the eight long-term studies, two (Klamath and Tyee) were composed almost entirely of this checkerboard pattern of ownership. Two types of study areas were included in the eight long-term studies: (1) density study areas, where all of the area within the boundary was surveyed each year, and (2) territorial study areas, where all known past and present owl territories were surveyed each year. The KSA was a territory based study area.

The Northwest Forest Plan (NWFP) designated forestland into several land use allocations (LUA's). One such LUA, Late Successional Reserves (LSR), were designed to maintain a functional, interacting, late-successional and old growth forest ecosystem across the range of the northern spotted owl (USDA and USDI, 1994). The KSA includes part or all of two LSR's designated under the NWFP.

Figure 1. Klamath Study Area boundary. Yellow and brown represent federally administered lands, brown represents Late Successional Reserves.




The checkerboard pattern made analysis by ownership or LUA difficult since virtually all sites within an LSR designation also encompass non-LSR within their home range. For the purpose of this analysis, a boundary was drawn around each of the two LSR's in the study. If sites were located within these boundaries they were considered in LSR, even though the private land within these boundaries was not actually designated as LSR.

The study monitored demographic parameters including survival rates, reproductive rates, and annual rate of population change. The protocol used to determine site occupancy, nesting, and reproductive status for this study follows the guidelines specified by the Northern Spotted Owl Effectiveness Monitoring Plan for the Northwest Forest Plan (Lint et al. 1999). An attempt was made to uniquely color band all newly detected owls and re-observe all previously banded individuals within the study. The re-observation of banded owls was used for the calculation of survival rates and population trends (Franklin et al. 1999, Burnham et al. 1996, Anthony et al. 2006, Forsman et al. 2011a).

## 6. Results for FY 2012:

### Survey Effort

There are currently 158 known spotted owl sites within the KSA (Appendix A). During the period of study, it was determined that four sites previously considered separate sites, were different use areas of another site and have since been combined with other sites. Of the 158 sites surveyed during 2012; 50 were occupied by a pair, 11 by a single, and 18 were occupied by one or two owls with unknown status (Appendix A). At least one spotted owl was detected at 79 (50.0 %) of the sites (Appendix A). There were no new sites documented within the study during 2012. Consistent occupancy by a territorial single or a pair is the usual criteria for designating a new site.

### Spotted Owl Occupancy

We identified 134 individual, non-juvenile, spotted owls (71 males and 63 females) in 2012, resulting in a male:female ratio of 1.13:1 (Appendix B). Of the 119 non-juvenile owls where age was determined, 110 (92.4%) were adults and 9 (7.6%) were subadults (Appendix B). The oldest known owl within the KSA was a male at least 18 years old. The oldest known female was at least 16 years old. A total of 18 owls were newly banded during 2012; eight (44.4%) were fledglings, four (22.2%) were adult, and six (33.3%) were subadults.

### Spotted Owl Reproduction

Yearly reproductive data (Appendix C, D) includes nesting attempts, nesting success, fecundity rate, and mean brood size. The proportion of nesting attempts is defined as the number of females that attempted to nest versus the number where nesting status was determined. Nesting success is defined as the proportion of nesting females that fledged young. The fecundity rate is defined as the number of female young produced per female versus the number of sites where the number of young produced was determined. The mean brood size is defined as the average number of young produced per successfully reproducing pair.

Where appropriate, the data were split into four female age classes; 1-year old, 2-year old, adult, and unknown age. The reproductive data were summarized two ways: (1) the entire KSA and (2) by LUA (LSR and non-LSR) (Appendix E).

There were a total of 50 sites where nesting status was determined in 2012, 10 territories nested (20.0%) and 40 territories did not nest (80.0%). Eight nesting attempts resulted in successfully fledged young and two failed, resulting in a nesting success rate of 80.0% (Appendix D).

The fecundity rate for all age classes in the KSA during 2012 was 0.191 (Appendix C). The fecundity rate for all sites during the years 1990-2012 was split into four female age classes. The rate for 1-year olds (0.061) was much lower than 2-year olds (0.296), adults (0.339), and unknown age class (0.250) (Table 1). Of the six pairs with at least one sub-adult male or female, none attempted to nest.

In 2012, the mean brood size was 1.50. The mean brood size for the years 1990-2012 was split into four female age classes, all known age classes resulted in similar values (Table 1).

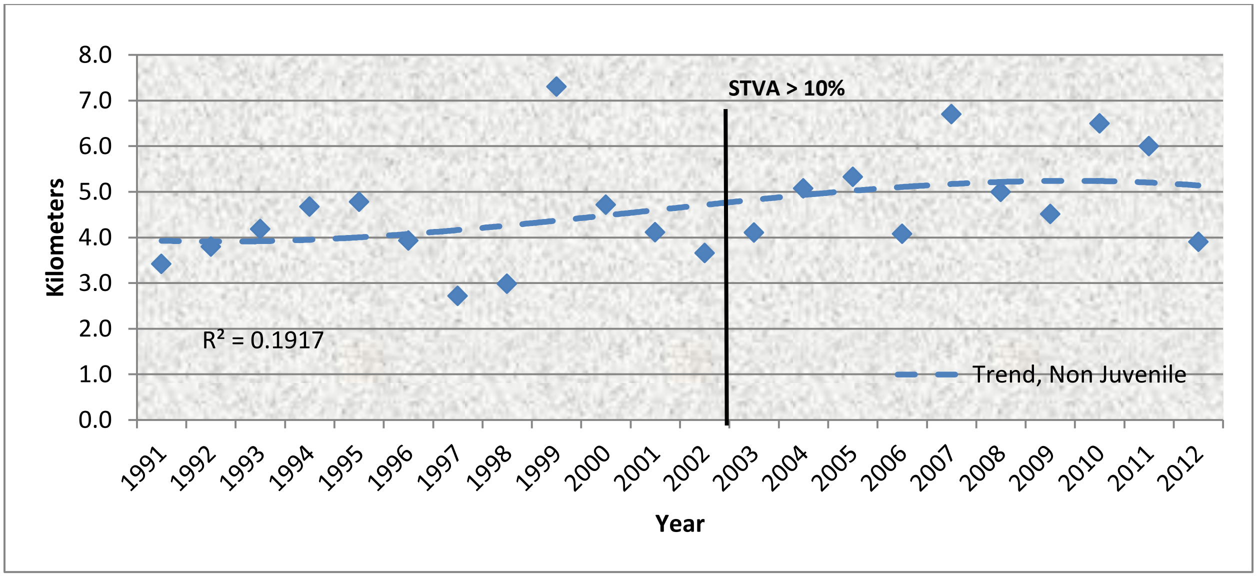
*Table 1. Fecundity rate and mean brood size by age class of female within the KSA (1990-2012).* [a]

| **Age class** | **Mean fecundity (N), 1990-2012** | **95% CI for fecundity** | **Mean brood size (N), 1990-2012** | **95% CI for brood size** |
|---|---|---|---|---|
| 1-yr | 0.061 (98) | 0.016-0.107 | 1.71 (7) | 1.35-2.08 |
| 2-yr | 0.296 (140) | 0.230-0.363 | 1.51 (55) | 1.38-1.64 |
| Adult | 0.339 (1383) | 0.315-0.362 | 1.58 (585) | 1.54-1.62 |
| Unk | 0.250 (44) | 0.147-0.353 | 1.29 (17) | 1.07-1.52 |
| Total | 0.320 | | 1.56 | |

[a] Preliminary data, values may change.

**Spotted Owl Dispersal**

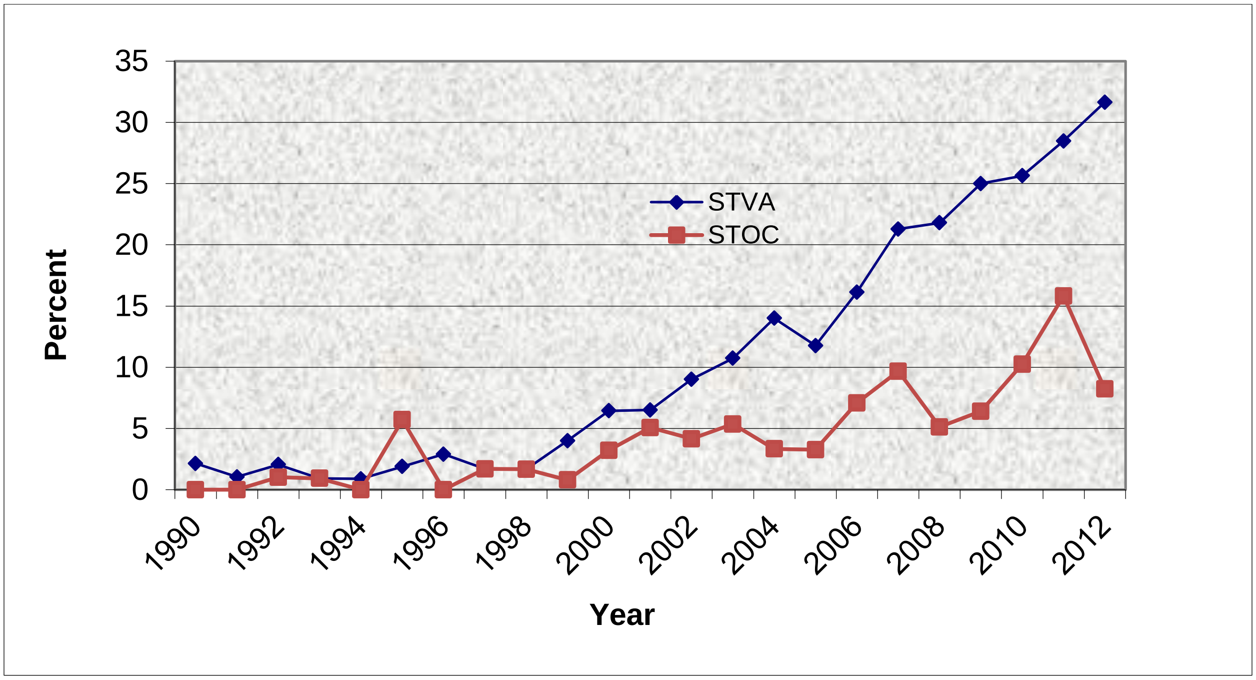
*Figure 2. The annual average distance of non-juvenile movements within the KSA (1990-2012). All movements are included; internal, immigration, and emigration. A polynomial trend line is plotted ($r^2$ = 0.192). The vertical line represents the first year STVA detections exceeded 10% of the sites surveyed.*




One non-juvenile was a known immigrant and two non-juveniles were known emigrants in 2012, on the KSA. Four owls originally banded as juveniles within the KSA were recaptured for the first time during 2012, three emigrated out of the study area and one was recaptured within the KSA (Appendix F).

The average distance for movements of non-juveniles, during 2012, was 3.9 km (2.4 mi); 2.8 km (1.7 mi) (N=12) for males and 4.8 km (3.0 mi) (N=14) for females (Figure 2). Within year movement of non-juveniles is documented when owls are positively identified at more than one site during the same year. The percent of within year movement is calculated as the number of owls identified at each different site versus the total number owls uniquely identified on the study (Appendix B and F). Within year movements of spotted owls have been increasing (Figure 3) as the percent of barred owl detections increases within the study area ($r^2 = 0.758$).

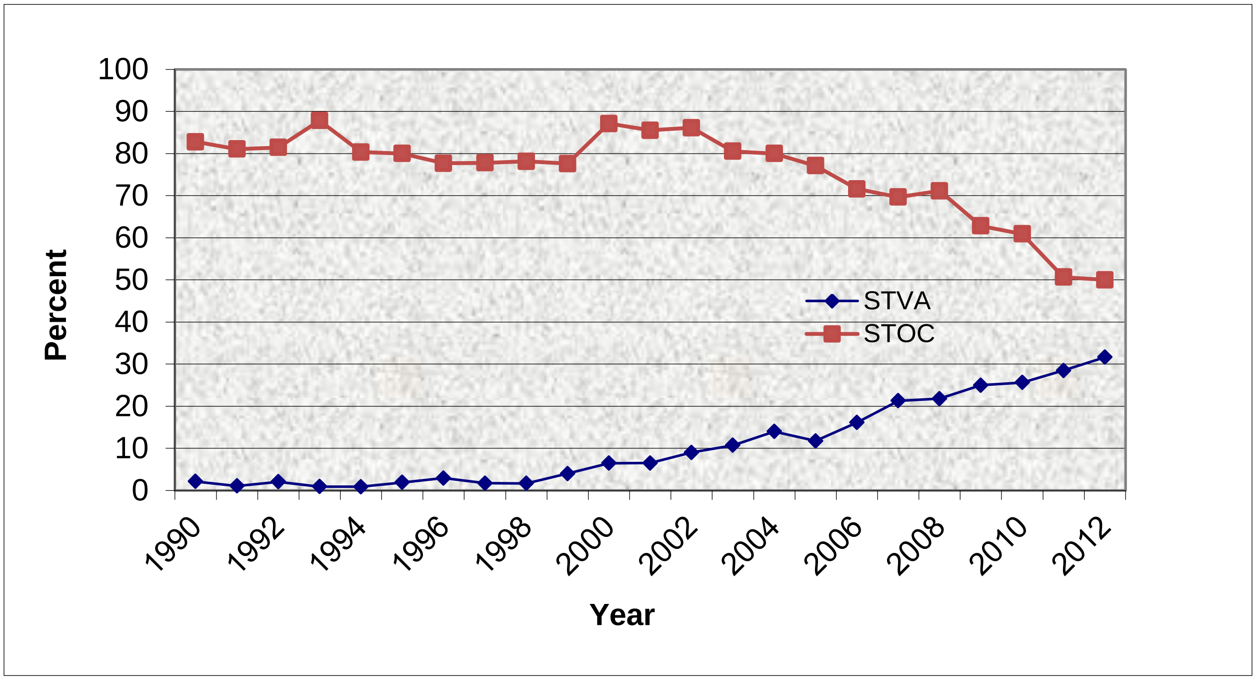
*Figure 3. Percentage of within year spotted owl movements versus sites with at least one barred owl detection. Klamath Study Area, 1990-2012.*




## Barred Owl

There were at least 83 non-juvenile barred owls (*Strix varia*) detected at 50 sites on the KSA during 2012. We detected a pair of barred owls at 25 sites, a single at 25 sites and at least one additional male at 5 of these sites. Fledglings were detected at 6 of the sites during 2012. There have been several hybrids detected in previous years, but no hybrids were detected in 2012. We compared the percentage of sites that were surveyed where at least one spotted owl was detected versus at least one barred owl detected (Figure 4). The barred owl detections were incidental to spotted owl surveys; therefore the number of sites with at least one barred owl detection is probably underestimated. The percentage of spotted owl sites with barred owl detections is steadily increasing, from less than 10% in all years previous to 2003, to greater than 10% in all years beginning with 2003 (Appendix A).

*Figure 4. Percentage of sites surveyed with at least one spotted owl detection versus sites with at least one barred owl detection. Klamath Study Area, 1990-2012.*



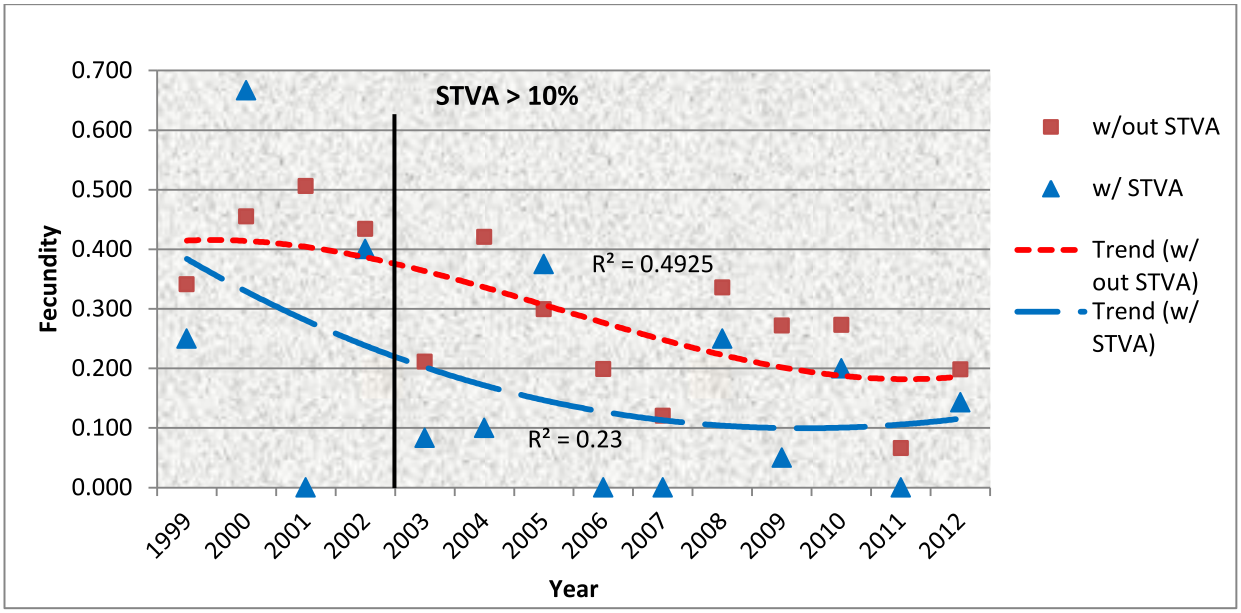

We compared the fecundity rate of spotted owls at sites with barred owl detections and sites without known barred owl detections (Figure 5). The fecundity rate during 2012 was 0.143 (N=7) at sites with barred owl presence, and 0.198 (N=50) at sites without known barred owl presence. The average spotted owl fecundity rate from 1999-2012 was 0.180 (N=77) at sites with barred owl presence, and 0.295 (N=1051) at sites without known barred owl presence. The beginning year of 1999 was chosen since it was the first year any barred owls were detected at a site where spotted owl reproductive status was determined. Before barred owl detections at all the sites within the study area exceeded 10% (1990-2002), the fecundity rate for all sites was 0.389 and the fecundity rate was 0.229 after barred owl detections at all the sites within the study area exceeded 10% (2003-2012). The 10% threshold was chosen to estimate the level of barred owl presence, below which there would be limited effect on spotted owl territories and population.

## 7. <u>Discussion for FY 2012</u>:

### Survey Effort

The survey effort within the KSA has varied over time, however the general trend has been an increase in the number of sites located and surveyed (Appendix A). The KSA boundaries were established in 1997 and the survey effort increased significantly until about 2003, and has remained relatively steady since. Although most of the area within this boundary is covered by territorial surveys, it is not a density study and some area may not be surveyed.

*Figure 5. Spotted owl fecundity rate at sites with and without known STVA detections (1999-2012). Polynomial trend lines are plotted. The vertical line represents the first year STVA detections exceeded 10% of the sites surveyed.*




**Spotted Owl Occupancy**

In recent years there has been a steady decline in the number of non-juveniles detected (Appendix B) and an even larger decrease in the number of pairs detected (Appendix A). The number of non-juveniles detected in 2012 (134) was the lowest ever documented on the study area (Appendix B). The number of individual spotted owls during 2012 was 39.6% fewer than the high of 222 during 2002. The decline in the number of pairs was even more sizeable, with 48.4% fewer detected in 2012 than the high of 97 during 2005. The 50 pairs detected during 2012 was the lowest number documented during the study period. Although the number of sites surveyed during this period has remained relatively constant, the number of pairs detected at sites has declined and the number of unoccupied sites has increased (Appendix A). While the recent meta-analysis (Forsman et al, 2011a) indicated that survival on the KSA was stable through 2006, the most recent data regarding occupancy has shown a rapid decline, which suggests the stability of the survival rate may no longer be valid.

The decrease in the number within the subadult age class is even more pronounced than the decrease within all non-juvenile age classes. The highest proportion of subadults ever documented in the KSA (25.1%) occurred during 2003 and has declined to under 10% during each of the past six years (Appendix B). Some of this decline may be explained by an extended period of very low fecundity corresponding to subsequent years of fewer subadults recruited into the population. Another indicator of recruitment is the number of juveniles banded on the KSA that survive and are subsequently recaptured within the KSA. Using only internal recruitments helps reduce the bias from varied survey effort at sites off the study area. The number of internal recruits remained fairly high from 2000 through 2007 and has been quite low the past five years. One juvenile previously banded within the KSA was recaptured within the KSA during 2012, this matched the previous low (Appendix F).

**Spotted Owl Reproduction**

Nesting status was determined at 50 of the sites (87.7%) where reproductive status was eventually determined during 2012. This high level of nest status determination results in a more accurate calculation of nest success and a more accurate count of the number of young fledged.

The nest success rate for 2012 (80.0%) was higher than the 1990-2012 average of 73.7%. Nesting success during 7 of the previous 10 years (2003-2012) were below the 22 year average (Appendix D), indicating an overall downward trend. Mean brood size was 1.50 in 2012, only slightly lower than the average for all years (1.56, Appendix C). Although the nest success rate and mean brood size during 2012 were near average, the recent trends are downward (Appendix C, D).

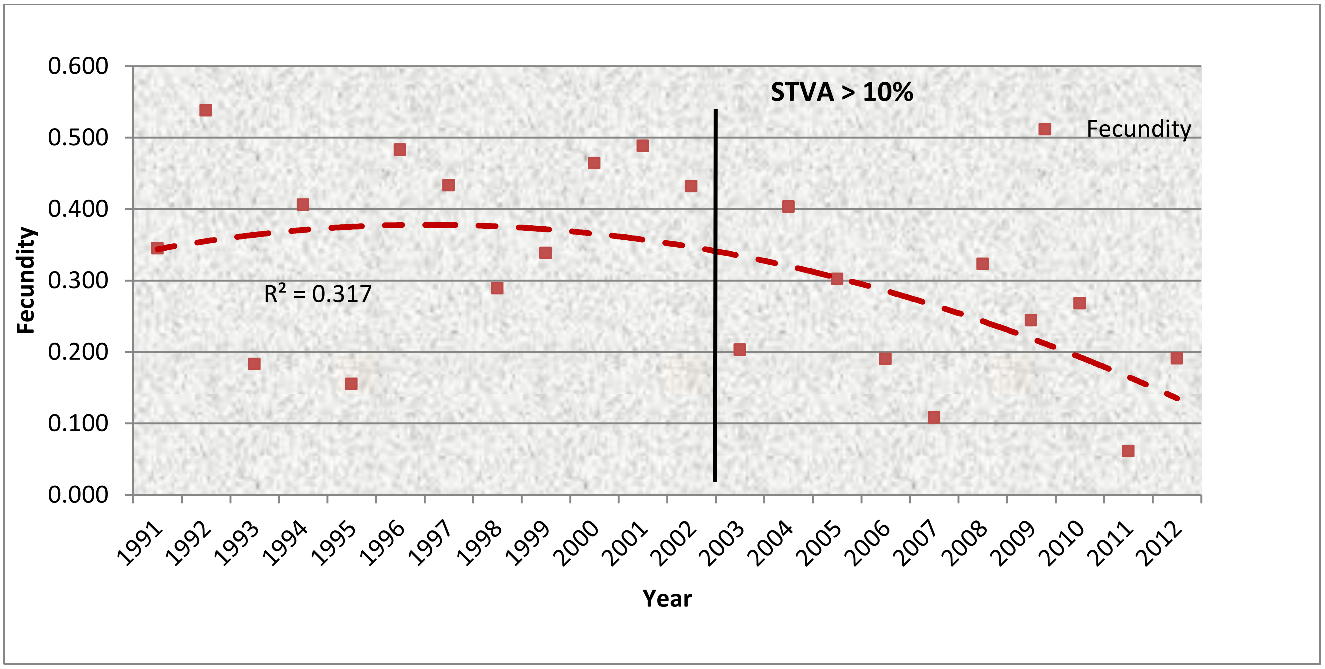
Glenn (2009) noted that there were negative associations with precipitation during the early nesting season within the Tyee Density study just north of the KSA. Rainfall within the KSA during the combined months of March through May 2012 was 32.3 cm (12.74 inches), the third highest during the 23 years of the study and well above the 20.3 cm (7.98 inch) average. The average temperature during May 2012 was 15.1° C (59.2° F), slightly above the average for the study period (Appendix G). When the KSA data are analyzed, there is a weak negative correlation ($r^2 = 0.310$) between precipitation and nest success during March through May. The high precipitation may help explain the extremely low nest success rate we calculated during 2010 and 2011 (Appendix G), which agrees with Glenn (2009), however our results through 2012 do not show a strong coorelation. The above average temperature during 2012 may have offset some of the negative effects of precipitation on nest success, but the data are inconclusive using recent trends.

Fecundity increases from 1-year old to adult age classes on the KSA. Our most recent analysis shows a very low fecundity rate of 0.061 for 1-year olds, while the rate for 2-year olds was similar to, but slightly lower than the adult rate (0.296 and 0.339, respectively) (Table 1). This follows the trend that Loschl (2008) reported for data from the Oregon Coast Range, where the mean annual number of young fledged increased at a constant rate from 1-year old through 4-year olds, then remained constant. Although fecundity rates varied by age class, the mean brood sizes did not appear to differ greatly among age classes.

The fecundity rate for 2012 was 0.191, which was lower than the average for the years 1990-2012 (0.320) (Appendix C). While the fecundity rate for spotted owls is known to fluctuate, we documented only 2 years during the most recent 10 years where the fecundity rate was above the overall average, indicating a downward trend (Figure 6). Forsman et al.

(2011a) noted that the fecundity rate on the KSA was declining and the most recent data agrees with this conclusion. The number of juveniles detected within the KSA during 2012 (12) was much lower than the overall median (44) and followed 2011 (7), the lowest number of juveniles ever detected on the study area (Appendix B). The 2011 and 2012 combination of the low fecundity rates, the lowest number of pairs ever documented, and the lowest number of non-juveniles ever documented may indicate potentially serious problems with maintaining a stable population. This is even more alarming since these results are following a long term downward trend.

*Figure 6. Spotted owl fecundity at all sites surveyed, KSA 1990-2012. A polynomial trend line is plotted ($r^2$ = 0.317). The vertical line represents the first year STVA detections exceeded 10% of the sites surveyed.*




The yearly fecundity rates for sites within an LSR compared to sites outside the LSR boundary are given in Appendix E. The NWFP became effective in the spring of 1994. Data presented here are for the combined years before and after the effective date. Fecundity rates for LSR sites compared to non-LSR sites, both before and after the NWFP implementation, indicate similar trends. There was a decrease in average fecundity rates after the NWFP implementation for both LSR (0.405 versus 0.292) and non-LSR (0.388 versus 0.304) sites. The fecundity rate during 1990-2012 was virtually identical for LSR sites and for non-LSR sites. Any effect on the population that may be due to habitat changes may be masked by a more influential stressor, the presence of the barred owl as discussed below.

**Barred Owl Influence on Spotted Owl Occupancy**

It is clear that the barred owl population is increasing across the range of the northern spotted owl. The most recent meta-analysis (Forsman et al., 2011a) indicates that the spotted owl populations have declined across most of the range, with the most significant declines occurring in Washington where the barred owl has been present the longest. Analysis of all three of the study areas in Washington indicated declining spotted owl populations. Although analysis within the KSA indicated a stable spotted owl population during the study period (1992-2006) (Forsman et al. 2011a), the recent data may indicate a change towards a declining population. The numbers of barred owls continued to increase, while spotted owl occupancy and fecundity continued to decrease.

There were at least 83 non-juvenile barred owls detected on the KSA during 2012. The numbers may be underestimated since detections were incidental while using spotted owl calls, and Wiens (2011) noted that barred owls were more likely to respond to a conspecific call versus a spotted owl call (0.66/visit vs. 0.48/visit). However, as the numbers of spotted owl pairs decline, any underestimation may become lower since Bailey et al. (2009) noted that barred owls are often twice as likely to be detected if spotted owls are not present. The number of barred owl detections was increasing during recent years and 2012 was the highest number ever detected. In addition, many of these detections appear to comprise more than one pair of barred owls within a single spotted owl site.

Using simple presence at a site, there was a proportional increase in the number of sites with barred owl detections during the last few years, agreeing with the number of individual detections noted above. Beginning in 2003, barred owls were detected at more than 10% of the sites surveyed in each subsequent year (Figure 4). Barred owls were detected on the highest percentage of sites during 2012, and the percentage of sites where spotted owls were detected was the lowest of any year.

There has been a rapid increase in barred owl detections on the Tyee Density study area north of the KSA (Forsman et al. 2011b). The number of sites on the Tyee Density study where barred owls were detected exceeded the number of sites where spotted owls were detected for the first time in 2009. The percent of sites where barred owls were detected exceeded 50% during the past 5 years and never exceeded 50% previous to that time. The trends on the KSA seem to be similar to the trends on the Tyee Density study with a 3-5 year lag period. It is probable that barred owls will continue their expansion south affecting spotted owl detections and population trends (Kelly 2001).

Bailey et al. (2009) and Crozier et al. (2006) determined that the presence of barred owls negatively affected the detection probabilities of spotted owls. Olson et al. (2005) determined that barred owl presence positively affected local-extinction probabilities or negatively affected colonization probabilities of spotted owls. They concluded that a further decline in the proportion of sites occupied by spotted owls is expected. The steady decline in the number of pairs and the number of non-juveniles on the KSA since 2002 (Appendix A, B) seems to indicate that the KSA population may be experiencing these effects.

Non-juvenile movement numbers, between years and within years, were fairly consistent within the study during recent years (2006-2012) (Appendix F) while fewer movements occurred during the years previous to large numbers of barred owl detections (1990-2005). Since fewer sites were surveyed in the earlier years, the numbers are not directly comparable but the trend is towards increasing numbers of movements. Data on the distance of non-juvenile movements indicated a slight upward trend in in distance moved during recent years (Figure 2). It has been postulated that the spotted owl population will experience internal movements in reaction to barred owl disruption of territories. Forsman et al (2011b) noted an increase of non-juvenile movements as well as an increase in the number of individuals located at multiple sites during the same year on the Tyee Density study area. There is a trend of increasing within year movements of spotted owls within the KSA (Figure 3) that appears to agree with Forsman et al. (2011b). While some of this increase may be due to crew experience and an increased ability to identify within year movements, the increase is large enough that it is likely real and possibly associated with barred owl presence. These data indicate that a disruption of territorial fidelity within the KSA may be occurring.

## Barred Owl Influence on Spotted Owl Reproduction

We compared fecundity rates at sites with and without barred owl influences using two methods. One method was a site specific rate that compares fecundity at sites with barred owl presence to sites where barred owls have not been detected. The second method is a coarse scale rate that compares the study wide fecundity during years with low barred owl presence (1990-2002) to years with higher barred owl presence (detections at >10% of sites) (2003-2012). Because barred owl detections were incidental, the results from sites where spotted owl reproduction was determined may be biased low. However, any survey bias comparing reproductive versus non reproductive sites should be somewhat similar since most visits to occupied sites occur diurnally. The site specific fecundity rate from 1999-2012 at sites with known barred owl presence was 0.180 compared to 0.295 at sites where barred owls were not detected. The average fecundity at a coarse scale was 0.389 (1990-2002) compared to 0.229 (2003-2012) (Figure 6). The site specific analysis and coarse scale analysis give similar results. These individual and cumulative year data indicate barred owl presence is having a negative impact on spotted owl reproduction and is consistent with findings from Forsman et al. (2011a) which included analysis of the KSA through 2008. Glenn (2009) and Olson et al. (2004) also noted that there was a negative association with barred owl presence and reproduction in their respective analysis.

There is mounting evidence that barred owls are negatively impacting the spotted owl population within the KSA. This is illustrated by several population trends beginning in 2003, when barred owl detections within the KSA exceed 10% of the sites: (1) spotted owl detections have been steadily decreasing (Figure 4) and reached the lowest point in 2012, when barred owl detections reached their highest level; (2) fecundity rates appear to be declining (Figure 6) and in only 2 of the previous 10 years was the rate above the 25 year average; and (3) the fecundity rate for sites with known barred owl presence was lower than at other sites. Forsman et al. (2011a) noted that the consistency of the negative associations between spotted owl demographic rates and the presence of barred owls supports the conclusion that barred owls are having a negative effect on spotted owl populations. The recent KSA data, with the combination of decreasing occupancy and reduced fecundity, seems to reinforce this conclusion.

## 8. Acknowledgments:

Many people and organizations contributed to the success of this project. Without the dozens of dedicated people collecting the field data, none of this could have been accomplished. In addition, biologists from surrounding areas have contributed information regarding owl movements. Several private timber companies have been gracious enough to allow access to sites on their property. Funding for range wide demographic studies comes from BLM, USDA Forest Service, and the National Park Service.

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Appendix A. Territories surveyed and occupancy results by year within the KSA (1990-2012). [a]

| Year | Total Sites[b] | Sites w/ STVA [c] | Sites w/ Pair[d] | Sites w/ single | Sites w/ undetermined status[e] | Total occupied sites | Sites w/ no occupation[f] | Sites w/ incomplete survey[g] |
|---|---|---|---|---|---|---|---|---|
| 1990 | 93 | 2 | 57 | 9 | 11 | 77 | 14 | 7 |
| 1991 | 95 | 1 | 60 | 11 | 4 | 77 | 18 | 11 |
| 1992* | 97 | 2 | 57 | 13 | 9 | 79 | 17 | 11 |
| 1993* | 107 | 1 | 66 | 15 | 13 | 94 | 13 | 9 |
| 1994* | 112 | 1 | 74 | 4 | 12 | 90 | 22 | 9 |
| 1995* | 105 | 2 | 60 | 11 | 13 | 84 | 18 | 17 |
| 1996 | 103 | 3 | 59 | 7 | 14 | 80 | 21 | 19 |
| 1997 | 117 | 2 | 61 | 12 | 18 | 91 | 25 | 9 |
| 1998* | 119 | 2 | 74 | 10 | 9 | 93 | 22 | 11 |
| 1999* | 125 | 5 | 74 | 9 | 14 | 97 | 25 | 7 |
| 2000* | 124 | 8 | 71 | 16 | 21 | 108 | 12 | 9 |
| 2001* | 138 | 9 | 86 | 12 | 16 | 118 | 20 | 1 |
| 2002 | 144 | 13 | 96 | 10 | 18 | 124 | 16 | 1 |
| 2003 | 149 | 16 | 96 | 11 | 13 | 120 | 21 | 0 |
| 2004 | 150 | 21 | 96 | 10 | 14 | 120 | 26 | 0 |
| 2005 | 153 | 18 | 97 | 12 | 9 | 118 | 31 | 1 |
| 2006 | 155 | 25 | 89 | 11 | 11 | 111 | 34 | 1 |
| 2007 | 155 | 33 | 82 | 15 | 11 | 108 | 38 | 1 |
| 2008 | 156 | 34 | 79 | 12 | 20 | 111 | 36 | 0 |
| 2009 | 156 | 39 | 76 | 8 | 14 | 98 | 52 | 0 |
| 2010 | 156 | 40 | 68 | 12 | 15 | 95 | 51 | 0 |
| 2011 | 158 | 45 | 52 | 13 | 15 | 80 | 58 | 0 |
| 2012 | 158 | 50 | 50 | 11 | 18 | 79 | 71 | 0 |

[a] Preliminary data, values may change.
[b] Sites surveyed to protocol. The sum of the last 3 columns may not equal the total sites since sites with the same individual located at 2 sites are not considered as occupied at one site.
[c] STVA occupancy is opportunistic and is defined as any detection at the site.
[d] Pair as defined in Lint et al 1999.
[e] Undetermined status may include one or 2 owls, does not qualify as a pair or single.
[f] No occupancy determined with at least 3 survey visits.
[g] Incomplete survey is 2 visits or less (usually no visits, only includes sites surveyed in previous years).
* represents years with a site where the pair was comprised of a spotted owl and a barred owl which was included as a "site with single".

Appendix B. Sex and age composition of spotted owls located within the KSA (1990-2012). Non-juvenile owls where the sex could not be determined are not included. [a]

| Year | Adult (M,F) | Subadult (M,F) | Percent Subadult | Age unk (M,F) [b] | Total non-juvenile (M,F) | Juvenile |
|---|---|---|---|---|---|---|
| 1990 | 102 (58,44) | 16 (10,6) | 13.6 | 22 (11,11) | 140 (79,61) | 52 |
| 1991 | 111 (60,51) | 18 (9,9) | 14.0 | 13 (6,7) | 142 (75,67) | 40 |
| 1992 | 106 (61,45) | 18 (8,10) | 14.5 | 18 (11,7) | 142 (80,62) | 59 |
| 1993 | 113 (61,52) | 24 (13,11) | 17.5 | 28 (17,11) | 165 (91,74) | 22 |
| 1994 | 122 (67,55) | 27 (12,15) | 18.1 | 18 (9,9) | 167 (88,79) | 55 |
| 1995 | 118 (66,52) | 9 (1,8) | 7.1 | 19 (14,5) | 146 (81,65) | 18 |
| 1996 | 110 (60,50) | 8 (4,4) | 6.8 | 29 (15,14) | 147 (79,68) | 56 |
| 1997 | 112 (57,55) | 22 (15,7) | 16.4 | 26 (11,15) | 160 (83,77) | 52 |
| 1998 | 127 (69,58) | 28 (15,13) | 18.1 | 20 (9,11) | 175 (93,82) | 41 |
| 1999 | 133 (74,59) | 17 (6,11) | 11.3 | 29 (14,15) | 179 (94,85) | 44 |
| 2000 | 136 (74,62) | 19 (10,9) | 12.3 | 28 (18,10) | 183 (102,81) | 65 |
| 2001 | 151 (80,71) | 35 (20,15) | 18.8 | 19 (14,5) | 205 (114,91) | 82 |
| 2002 | 154 (85,69) | 48 (21,27) | 23.8 | 21 (14,7) | 223 (120,103) | 83 |
| 2003 | 152 (85,67) | 51 (23,28) | 25.1 | 14 (10,4) | 217 (118,99) | 38 |
| 2004 | 171 (93,78) | 29 (11,18) | 14.5 | 19 (14,5) | 219 (118,101) | 75 |
| 2005 | 191 (106,85) | 19 (3,16) | 9.0 | 8 (7,1) | 218 (116,102) | 61 |
| 2006 | 170 (91,79) | 19 (5,14) | 10.1 | 14 (11,3) | 203 (107,96) | 35 |
| 2007 | 162 (85,77) | 16 (7,9) | 9.0 | 12 (8,4) | 190 (100,90) | 19 |
| 2008 | 161 (82,79) | 9 (4,5) | 6.3 | 21 (13,8) | 191 (99,92) | 53 |
| 2009 | 150 (76,74) | 10 (5,5) | 5.2 | 15 (12,3) | 175 (93,82) | 38 |
| 2010 | 137 (71,66) | 12 (7,5) | 8.1 | 20 (12,8) | 169 (90,79) | 38 |
| 2011 | 111 (58,53) | 8 (5,3) | 6.7 | 17 (14,3) | 136 (77,59) | 7 |
| 2012 | 110 (54,56) | 9 (7,2) | 7.6 | 15 (10,5) | 134 (71,63) | 12 |

[a] Preliminary data, values may change.
[b] It is possible some of the unknown are auditory responses and the same individuals as included in another category.

Appendix C. Fecundity rate and mean brood size by year within the KSA (1990-2012). Years with an * represent years when backpack transmitters were attached to females during the nesting season, these sites are excluded from the calculation. [a]

| Year | Mean fecundity (N) | 95% CI for fecundity | Mean brood size (N) | 95% CI for brood size |
|---|---|---|---|---|
| 1990* | 0.510 (49) | 0.387-0.633 | 1.61 (31) | 1.44-1.79 |
| 1991* | 0.345 (58) | 0.229-0.461 | 1.67 (24) | 1.44-1.89 |
| 1992* | 0.538 (53) | 0.423-0.652 | 1.50 (38) | 1.31-1.69 |
| 1993 | 0.183 (60) | 0.096-0.270 | 1.47 (15) | 1.21-1.73 |
| 1994 | 0.406 (69) | 0.293-0.519 | 1.81 (31) | 1.64-1.97 |
| 1995 | 0.155 (58) | 0.074-0.236 | 1.38 (13) | 1.11-1.66 |
| 1996 | 0.483 (58) | 0.378-0.588 | 1.47 (38) | 1.34-1.61 |
| 1997 | 0.433 (60) | 0.316-0.551 | 1.73 (30) | 1.57-1.89 |
| 1998 | 0.285 (72) | 0.198-0.371 | 1.37 (30) | 1.19-1.54 |
| 1999 | 0.338 (65) | 0.231-0.446 | 1.69 (26) | 1.51-1.87 |
| 2000 | 0.464 (70) | 0.366-0.563 | 1.51 (43) | 1.36-1.66 |
| 2001 | 0.488 (84) | 0.387-0.589 | 1.78 (46) | 1.66-1.90 |
| 2002 | 0.432 (96) | 0.344-0.520 | 1.60 (52) | 1.49-1.70 |
| 2003 | 0.203 (96) | 0.136-0.271 | 1.34 (29) | 1.17-1.52 |
| 2004 | 0.403 (93) | 0.316-0.491 | 1.56 (48) | 1.42-1.70 |
| 2005 | 0.302 (101) | 0.220-0.384 | 1.61 (38) | 1.45-1.76 |
| 2006 | 0.190 (92) | 0.116-0.264 | 1.59 (22) | 1.38-1.80 |
| 2007 | 0.108 (88) | 0.046-0.170 | 1.73 (11) | 1.45-2.00 |
| 2008 | 0.323 (82) | 0.238-0.409 | 1.43 (37) | 1.27-1.59 |
| 2009 | 0.244 (78) | 0.153-0.334 | 1.73 (22) | 1.54-1.92 |
| 2010 | 0.268 (72) | 0.181-0.355 | 1.41 (27) | 1.22-1.60 |
| 2011 | 0.063 (56) | 0.006-0.119 | 1.40 (5) | 0.92-1.88 |
| 2012 | 0.191 (57) | 0.005-0.377 | 1.50 (8) | 1.13-1.87 |
| **1990-2012** | **0.320** | | **1.56** | |

[a] Preliminary data, values may change.

Appendix D. Proportion of nesting attempts at sites with nest status determined, and proportion of nest success by year within the KSA (1990-2012). Years with an * represent years when backpack transmitters were attached to females during the nesting season, these sites are excluded from the calculation. [a]

| Year | Nest Attempt Proportion (N) | 95% CI for Nest Attempts | Nest Success Proportion (N) | 95% CI for Nest Success |
|---|---|---|---|---|
| 1990* | 0.821 (39) | 0.698-0.943 | 0.750 (32) | 0.598-0.902 |
| 1991* | 0.681 (47) | 0.546-0.816 | 0.688 (32) | 0.524-0.851 |
| 1992* | 0.783 (46) | 0.662-0.903 | 0.889 (36) | 0.785-0.993 |
| 1993 | 0.391 (46) | 0.249-0.534 | 0.722 (18) | 0.509-0.935 |
| 1994 | 0.569 (58) | 0.440-0.698 | 0.818 (33) | 0.685-0.952 |
| 1995 | 0.439 (41) | 0.285-0.593 | 0.667 (18) | 0.443-0.891 |
| 1996 | 0.829 (41) | 0.713-0.946 | 0.853 (34) | 0.732-0.974 |
| 1997 | 0.540 (50) | 0.400-0.680 | 0.963 (27) | 0.890-1.036 |
| 1998 | 0.654 (52) | 0.523-0.784 | 0.618 (34) | 0.452-0.783 |
| 1999 | 0.472 (53) | 0.336-0.607 | 0.880 (25) | 0.750-1.010 |
| 2000 | 0.776 (58) | 0.668-0.884 | 0.844 (45) | 0.737-0.952 |
| 2001 | 0.707 (75) | 0.603-0.810 | 0.849 (53) | 0.752-0.946 |
| 2002 | 0.667 (90) | 0.569-0.765 | 0.850 (60) | 0.759-0.941 |
| 2003 | 0.506 (83) | 0.398-0.614 | 0.595 (42) | 0.445-0.745 |
| 2004 | 0.614 (88) | 0.511-0.716 | 0.852 (54) | 0.756-0.947 |
| 2005 | 0.593 (91) | 0.492-0.695 | 0.611 (54) | 0.480-0.742 |
| 2006 | 0.375 (88) | 0.273-0.477 | 0.606 (33) | 0.437-0.775 |
| 2007 | 0.221 (77) | 0.128-0.314 | 0.647 (17) | 0.413-0.881 |
| 2008 | 0.622 (74) | 0.510-0.733 | 0.783 (46) | 0.662-0.903 |
| 2009 | 0.449 (69) | 0.331-0.568 | 0.677 (31) | 0.510-0.845 |
| 2010 | 0.787 (61) | 0.683-0.891 | 0.500 (48) | 0.357-0.643 |
| 2011 | 0.204 (49) | 0.090-0.318 | 0.500 (10) | 0.173-0.827 |
| 2012 | 0.200 (50) | 0.088-0.312 | 0.800 (10) | 0.539-1.061 |
| **1990-2012** | **0.561** | | **0.737** | |

[a] Preliminary data, values may change.

Appendix E. Fecundity rate and mean brood size by Land Use Allocation and year within the KSA. Years with an * represent years when backpack transmitters were attached to females during the nesting season, these sites are excluded from the calculation. [a]

| Year | LSR, Mean fecundity (N) | LSR, 95% CI for fecundity | Non-LSR, Mean fecundity (N) | Non-LSR, 95% CI for fecundity |
|---|---|---|---|---|
| 1990* | 0.481 (27) | 0.312-0.651 | 0.545 (22) | 0.364-0.727 |
| 1991* | 0.383 (30) | 0.223-0.544 | 0.304 (28) | 0.134-0.473 |
| 1992* | 0.589 (28) | 0.422-0.757 | 0.480 (25) | 0.325-0.635 |
| 1993 | 0.214 (28) | 0.077-0.352 | 0.156 (32) | 0.045-0.268 |
| 1994 | 0.357 (35) | 0.194-0.521 | 0.456 (34) | 0.299-0.613 |
| 1995 | 0.145 (31) | 0.032-0.258 | 0.167 (27) | 0.050-0.284 |
| 1996 | 0.485 (33) | 0.347-0.623 | 0.480 (25) | 0.315-0.645 |
| 1997 | 0.533 (30) | 0.371-0.696 | 0.333 (30) | 0.168-0.498 |
| 1998 | 0.294 (34) | 0.176-0.412 | 0.276 (38) | 0.150-0.403 |
| 1999 | 0.333 (33) | 0.176-0.491 | 0.344 (32) | 0.195-0.493 |
| 2000 | 0.444 (36) | 0.305-0.584 | 0.485 (34) | 0.345-0.626 |
| 2001 | 0.500 (43) | 0.362-0.638 | 0.476 (41) | 0.327-0.625 |
| 2002 | 0.489 (46) | 0.358-0.620 | 0.380 (50) | 0.263-0.497 |
| 2003 | 0.191 (47) | 0.090-0.293 | 0.214 (49) | 0.124-0.305 |
| 2004 | 0.409 (44) | 0.273-0.545 | 0.398 (49) | 0.284-0.512 |
| 2005 | 0.202 (47) | 0.100-0.304 | 0.389 (54) | 0.268-0.509 |
| 2006 | 0.113 (40) | 0.023-0.202 | 0.250 (52) | 0.141-0.359 |
| 2007 | 0.051 (39) | 0.000-0.121 | 0.153 (49) | 0.057-0.249 |
| 2008 | 0.319(36) | 0.195-0.444 | 0.326 (46) | 0.207-0.445 |
| 2009 | 0.181 (36) | 0.056-0.305 | 0.298 (42) | 0.168-0.427 |
| 2010 | 0.317 (30) | 0.165-0.469 | 0.232 (42) | 0.130-0.334 |
| 2011 | 0.075 (20) | 0.000-0.155 | 0.056 (36) | 0.000-0.131 |
| 2012 | 0.158 (19) | 0.007-0.309 | 0.208 (38) | 0.000-0.481 |
| **1990-1994** | **0.405** | | **0.388** | |
| **1995-2012** | **0.292** | | **0.304** | |
| **1990-2012** | **0.316** | | **0.322** | |

[a] Preliminary data, values may change.

Appendix F. Internal recruitment and internal movement within the KSA (1990-2012). [a]

| Year | Juvenile recruitment | Total non-juv movement, between years | Total non-juv movement, within year |
|---|---|---|---|
| 1990 | 5 | 1 | 0 |
| 1991 | 8 | 3 | 0 |
| 1992 | 4 | 5 | 1 |
| 1993 | 6 | 5 | 1 |
| 1994 | 5 | 13 | 0 |
| 1995 | 1 | 3 | 6 |
| 1996 | 4 | 11 | 0 |
| 1997 | 11 | 10 | 2 |
| 1998 | 10 | 7 | 2 |
| 1999 | 8 | 9 | 1 |
| 2000 | 10 | 6 | 4 |
| 2001 | 17 | 10 | 7 |
| 2002 | 14 | 10 | 6 |
| 2003 | 17 | 16 | 8 |
| 2004 | 10 | 8 | 5 |
| 2005 | 10 | 12 | 5 |
| 2006 | 8 | 15 | 11 |
| 2007 | 17 | 18 | 15 |
| 2008 | 4 | 15 | 8 |
| 2009 | 9 | 16 | 10 |
| 2010 | 5 | 15 | 16 |
| 2011 | 2 | 15 | 25 |
| 2012 | 1 | 23 | 13 |
| **1990-2012** | | | |

[a] Preliminary data, values may change.

Appendix G. Average precipitation and temperature at Western Regional Climate Center weather station #357169, Riddle, Oregon. [a]

| Year | March-May precipitation | May ave temp, F |
|---|---|---|
| 1990 | 3.63 | 55.6 |
| 1991 | 10.55 | 53.9 |
| 1992 | 5.40 | 63.0 |
| 1993 | 9.32 | 59.6 |
| 1994 | 4.66 | 59.4 |
| 1995 | 9.95 | 58.3 |
| 1996 | 11.00 | 56.3 |
| 1997 | 7.48 | 61.6 |
| 1998 | 14.92 | 54.2 |
| 1999 | 5.03 | 54.3 |
| 2000 | 6.57 | 58.6 |
| 2001 | 4.53 | 60.6 |
| 2002 | 4.21 | 55.5 |
| 2003 | 8.48 | 56.7 |
| 2004 | 4.23 | 59.0 |
| 2005 | 12.27 | 59.7 |
| 2006 | 8.53 | 59.4 |
| 2007 | 4.28 | 58.4 |
| 2008 | 5.54 | 58.8 |
| 2009 | 5.32 | 59.2 |
| 2010 | 12.10 | 55.5 |
| 2011 | 12.81 | 55.5 |
| 2012 | 12.74 | 59.2 |
| **1990-2012** | **7.98** | **57.9** |

[a] Preliminary data, values may change.